

## MAX33015E Shield

Evaluates: MAX33014E,  
MAX33015E

### General Description

The MAX33015E Shield is a fully assembled and tested Printed Circuit Board (PCB) that demonstrates the functionality of the MAX33015E, a high  $\pm 65\text{V}$  fault-protection,  $\pm 25\text{V}$  common-mode input range,  $\pm 45\text{kV}$  ESD Human Body Model (HBM) controller area network (CAN) transceiver. The Mbed/Arduino shield can also be used as a standalone evaluation board. The shield features a digital isolator, which is used as a level translator between the CAN transceiver and the controller interface.

### Features

- Easy Evaluation of the MAX33015E
- I/O Interface Compatibility from 1.71V to 5.5V
- Proven PCB Layout
- Mbed/Arduino Platform Compatible
- Fully Assembled and Tested

[Ordering Information](#) appears at end of data sheet.

### Quick Start

#### Required Equipment

- MAX33015E Shield
- 5V, 500mA DC power supply
- Signal/function generator that can generate a 2.5MHz square wave signal
- Oscilloscope

#### Procedure

- 1) Place the MAX33015E Shield on a nonconductive surface to ensure nothing on the PCB gets shorted to the workspace.
- 2) Set all jumpers in their default position as shown in [Table 1](#).
- 3) With the +5V power supply disabled, connect the positive terminal to the VDD\_EXT, VL\_EXT, and IOREF test points. Connect the negative terminal to the GND test point.
- 4) Connect the positive terminal of the function generator to the D1 pin of JU8 and negative terminal to any GND test points on the shield.
- 5) Set the function generator to output a 2.5MHz square wave between 0V and 5V, and then enable the function generator output.
- 6) Turn on the +5V DC power Supply.
- 7) Connect an oscilloscope probe on the RXD test point and verify the RXD output signal matches the TXD input signal.

PRELIMINARY

Table 1. Table Jumper Settings

JUMPER	SHUNT POSITION	DESCRIPTION
JU_CANH and JU_ CANL	1-2	Connects 120.8Ω between CANH and CANL
	2-3*	Connects 60.4Ω between CANH and CANL
	Open	No load is connected between CANH and CANL
JU1	1-2	VDD is shorted to 5V supply
	2-3*	VDD is shorted to VDD_EXT supply
	Open	VDD is open
JU8	-	Refer to TXD and RXD configuration
JU9	1-2	Connects STBY to D7 of JU8
JU10	Open*	Disconnects STBY from D7 of JU8
JU10 JU12	1-2*	Connects TVS diode to CANL
	Open	Disconnects TVS diode to CANL
JU12	1-2*	Connects STBY to ground
	1-3	Connects STBY to a 26.1KΩ resistor to ground
	1-4	Connects STBY to the U2's OUTB2 pin used for Arduino/Mbed interface
	Open	Internal pullup for standby mode
JU5	1-2*	Connects 15pF capacitor between receiver output and ground
	Open	Disconnects 15pF capacitor between receiver output and ground
JU20	1-2*	Connects TVS diode to CANH
	Open	Disconnects TVS diode from CANH
JU15	1-2	LPBK is shorted to VL
	2-3	LPBK is shorted to GND
	Open*	LPBK is open
JU7	1-2	FAULT is shorted to D8 pin of JU8
	Open*	FAULT is open
JU16	1-2	LPBK is shorted to D6 pin of JU8
	Open*	LPBK is open
JU13	1-2	CANH and CANL are shorted
	Open*	CANH and CANL are not shorted
JU6	1-2	FAULT connected to IOREF with 100K pullup
	2-3*	FAULT connected to VL with 100K pullup
	Open	FAULT is open
JU14	1-2	VL is shorted to 5V supply
	2-3*	VL is shorted to VDD_EXT supply
	Open	VL is open
JU2	1-2*	TXD_U1 is connected to TXD through MAX14131
	Open	Can apply signal directly on TXD_U1
JU3	1-2*	LPBK_U1 is connected to LPBK through MAX14131
	Open	Can apply signal directly on LPBK_U1
JU4	1-2*	RXD_U1 is connected to RXD through MAX14131
	Open	Can observe signal directly on RXD_U1

Note: \* indicates default jumper state.

PRELIMINARY

### Transmission Failure, Overcurrent, and Overvoltage Fault Detection Procedure

To test the fault detection, 100 pulses on the TXD are required to enable the fault detection circuitry. There are three different faults that can be tested. After each fault condition is applied, the fault pin goes high. Send 16 pulses on the TXD to observe the fault code on RXD. Additional 10 pulses on the TXD are required to clear the fault and another 100 pulses on the TXD to enable fault detection again.

#### 1) Transmission Failure Fault Detection:

- Remove jumpers JU\_CANH and JU\_CANL. As the CAN Bus does not have any termination, the MAX33015E detects a 'Transmission Failure' fault.
- Connect an oscilloscope probe on the RXD test point and verify the RXD output signal shows fault code '110010'.

#### 2) Overcurrent Fault Detection:

- Connect a short wire between the pin#2 of JU\_CANH and pin#2 of JU\_CANL. As the CANH and CANL lines are shorted to each other, the MAX33015E detects an 'Overcurrent' fault.
- Verify the RXD output signal shows fault code '101010'.

#### 3) Overvoltage Fault Detection:

- Remove the wire and follow the setup instructions in [Figure 1](#) of the MAX33015E data sheet to observe 'Overvoltage' fault. The recommended RCM value is 150Ω and VCM value is 30V to detect 'Overvoltage' fault.
- Verify the RXD output signal shows fault code '100110'.

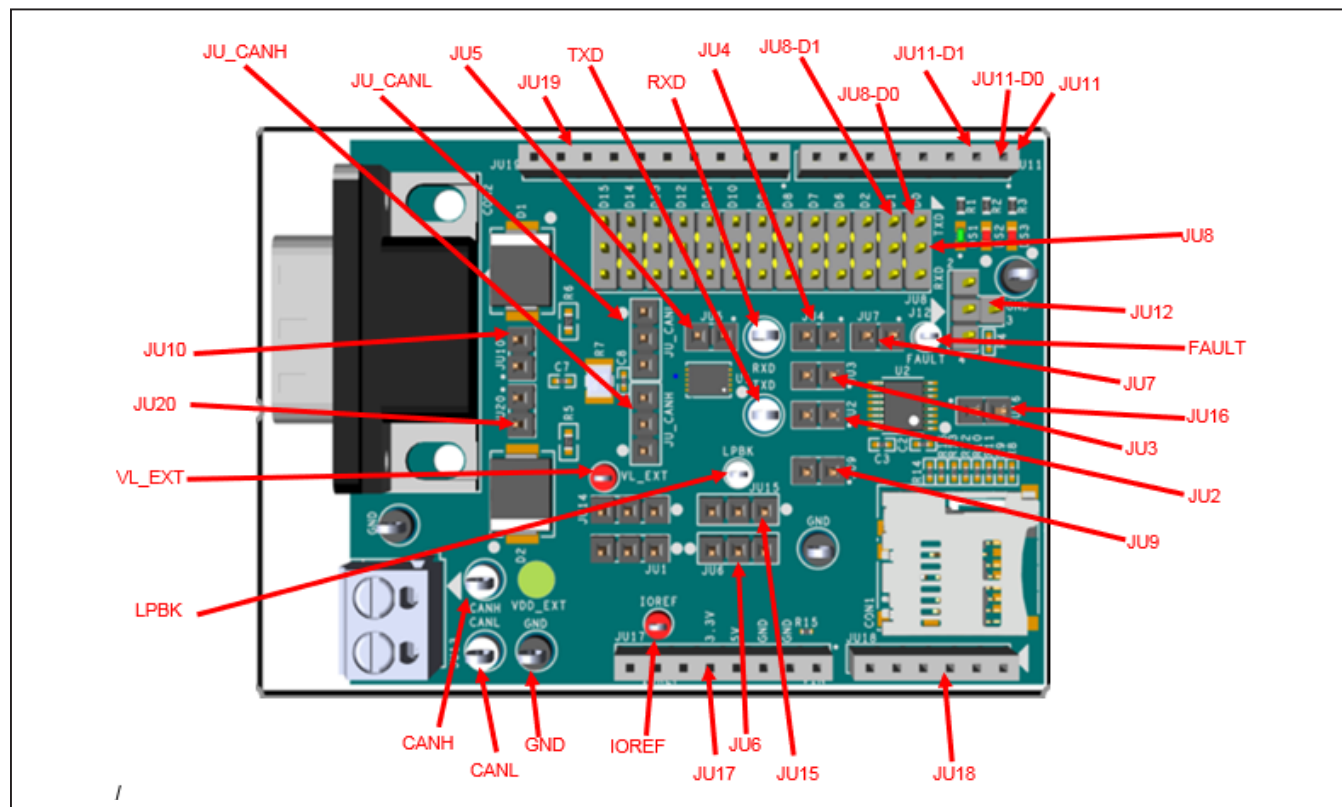


Figure 1. EV Kit with Jumpers and Positions of Test Points

PRELIMINARY

## Detailed Description of Hardware

The MAX33015E Shield is a fully assembled and tested circuit board to evaluate the MAX33015E fault-protected high-speed CAN transceiver (U1) with  $\pm 65V$  fault protection, fault detection, and reporting. The Shield is designed to evaluate the MAX33015E alone or in a CAN system. The MAX33015E Shield enables the Mbed or Arduino platform to communicate on a CAN bus. The MAX14932 digital isolator is used as a level translator with a 1.71V to 5.5V supply range.

### Powering the Board

The MAX33015E Shield requires one power supply for 5V operation and another for VL operation. The power supplies can come from an external supply or from the Arduino/Mbed microcontroller's 5V supply. Shunt the JU1 VDD pin to the VDD\_EXT pin option (2-3 default position) and JU14 VL pin to the VL\_EXT pin option (2-3 default position) to select the external supply. Shunt the JU1 VDD pin to 5V (1-2 position) and JU14 VL pin to 5V (1-2 position) to connect the Arduino/Mbed 5V supply to VDD.

### On-Board Termination

A properly terminated CAN bus is terminated at each end with the characteristic impedance of the cable. For CAT5 or CAT6 cables, this is typically 120 $\Omega$  on each end for a 60 $\Omega$  load on the CAN driver. The MAX33015E Shield features a selectable 60 $\Omega$  load and a 60 $\Omega$ -60 $\Omega$

split termination circuit between the CANH and CANL driver outputs. The 60 $\Omega$ -60 $\Omega$  split termination has a footprint for a capacitor to reduce high-frequency noise and common-mode drift. If the board is evaluated in a system and is connected at the end of the cable, then select the 120 $\Omega$  (60 $\Omega$ -60 $\Omega$  split) termination. To simulate a complete system without connecting to another CAN transceiver, change the termination resistors on the MAX33015E Shield to a 60 $\Omega$  with optional footprint for a 100pF load.

### TXD and RXD Configuration

The digital channels for TXD and RXD are selected through the JU8. It consists of three columns and 14 rows. The columns labeled TXD and RXD are connected to the MAX33015E through the digital isolator U2. The middle column is the digital I/O pins, D0 to D13. This provides flexibility to select different resources on the microcontroller to transmit and receive signals to and from the CAN transceiver. [Table 2](#) shows the list of JU8 jumper options.

### DB9 Connector

The MAX33015E Shield has a DB9 connector to the CANH and CANL (pins 7 and 6, respectively).

### SD Card

The MAX33015E Shield has a SD Card socket. The Micro SD card is connected to D10-D13 to interface with the Arduino/Mbed board through the SPI interface.

**Table 2. Table TXD and RXD Jumper Setting**

JUMPER	SHUNT POSITION	DESCRIPTION
JU8	1-2	Connects TXD to D0
	4-5*	Connects TXD to D1
	7-8	Connects TXD to D2
	10-11	Connects TXD to D6
	13-14	Connects TXD to D7
	16-17	Connects TXD to D8
	19-20	Connects TXD to D9
	22-23	Connects TXD to D10
	25-26	Connects TXD to D11
	28-29	Connects TXD to D12
	31-32	Connects TXD to D13
	34-35	Connects TXD to D14
	37-38	Connects TXD to D15

JUMPER	SHUNT POSITION	DESCRIPTION
JU8	2-3*	Connects RXD to D0
	5-6	Connects RXD to D1
	8-9	Connects RXD to D2
	11-12	Connects RXD to D6
	14-15	Connects RXD to D7
	17-18	Connects RXD to D8
	20-21	Connects RXD to D9
	23-24	Connects RXD to D10
	26-27	Connects RXD to D11
	29-30	Connects RXD to D12
	32-33	Connects RXD to D13
	35-36	Connects RXD to D14
	38-39	Connects RXD to D15

Note: \* indicates default jumper state.

## Ordering Information

PART	TYPE
MAX33015ESHLD#	Shield

## MAX33015E Shield

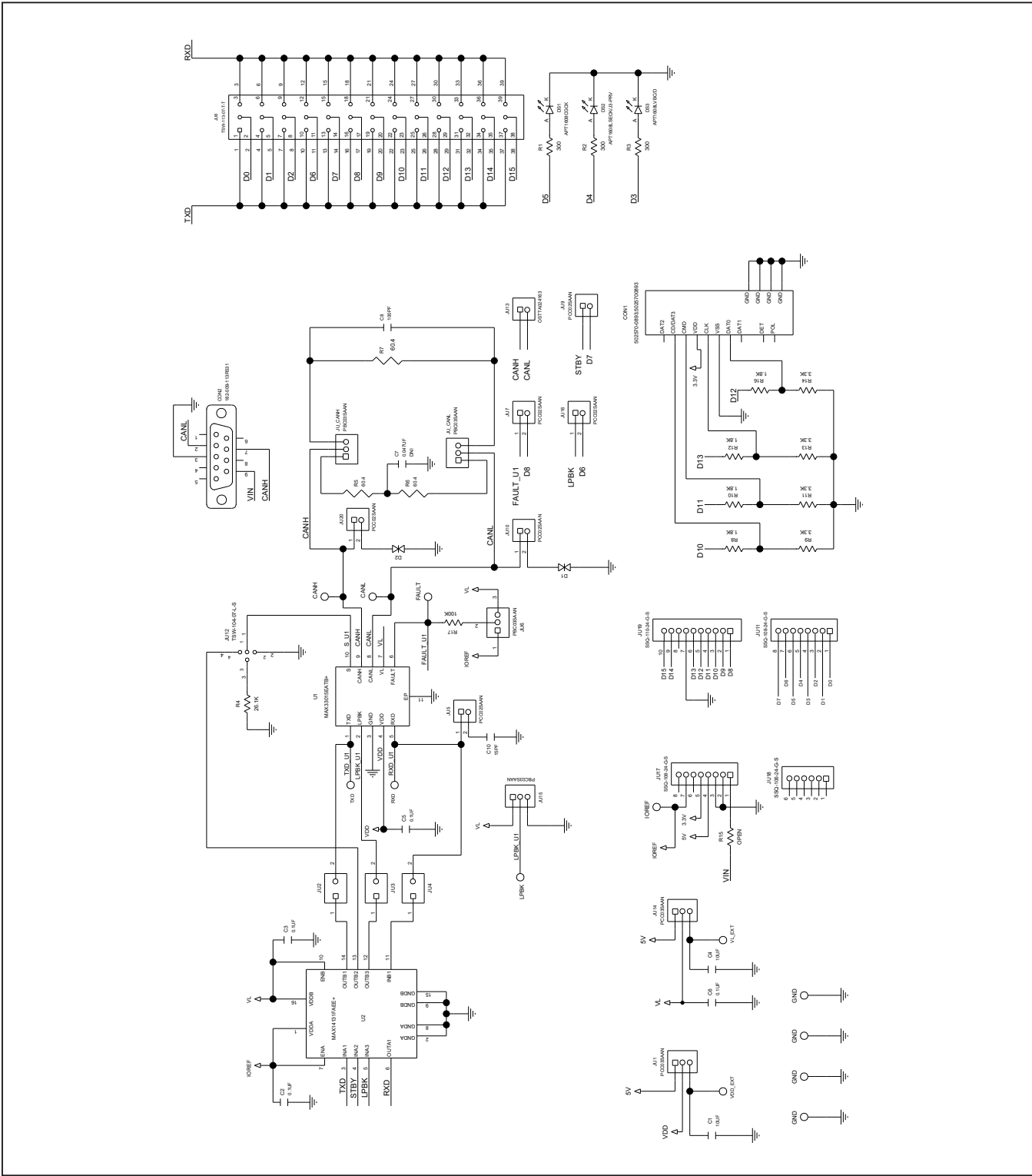
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MAX33015E

## MAX33015E EV Bill of Materials

NOTE: DNI -> DO NOT INSTALL (PACKOUT); DNP -> DO NOT PROCURE							
ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	C1, C4	-	2	CL21B106KQNNN; GRM21BZ71C106KE15; GMC21X7R106K16NT	SAMSUNG;MURATA; CAL-CHIP	10UF	CAP; SMT (0805); 10UF; 10%; 16V; X7R; CERAMIC
2	C2, C3, C5, C6	-	4	C0402C104J4RAC; GCM155R71C104JA55	KEMET;MURATA	0.1UF	CAP; SMT (0402); 0.1UF; 5%; 16V; X7R; CERAMIC
3	C8	-	1	C0402C101J5GAC; NMC0402NPO101J; CC0402JRNPO9BN101; GRM1555C1H101JA01; C1005C0G1H101J050BA	KEMET;NIC COMPONENTS CORP.;YAGEO PHICOMP; MURATA;TDK;TDK	100PF	CAP; SMT (0402); 100PF; 5%; 50V; C0G; CERAMIC
4	C10	-	1	C0402C0G500-150JNP; GRM1555C1H150JA01	VENKEL LTD.;MURATA	15PF	CAP; SMT (0402); 15PF; 5%; 50V; C0G; CERAMIC
5	CANH, CANL, RXD, TXD	-	4	5012	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
6	CON1	-	1	502570-0893;5025700893	MOLEX;MOLEX	502570-0893; 5025700893	CONNECTOR; FEMALE; SMT; MICROSD CARD CONNECTOR; RIGHT ANGLE; 10PINS
7	CON2	-	1	182-009-113R531	NORCOMP	182-009-113R531	CONNECTOR; MALE; THROUGH HOLE; D-SUBMINIATURE CONNECTOR; RIGHT ANGLE; 9PINS
8	D1, D2	-	2	SM15T30CA	ST MICROELECTRONICS	25.6V	DIODE; TVS; SMC (DO-214AB); VRM=25.6V; IPP=36A
9	DS1	-	1	APT1608CGCK	KINGBRIGHT	APT1608CGCK	DIODE; LED; STANDARD; GREEN; SMT (0603); PIV=2.1V; IF=0.02A; -40 DEGC TO +85 DEGC
10	DS2	-	1	APT1608LSECK/J3-PRV	KINGBRIGHT	APT1608LSECK/ J3-PRV	DIODE; LED; HYPER RED WATER CLEAR; RED; SMT (0603); VF=1.8V; IF=0.002A
11	DS3	-	1	APT1608LVBC/D	KINGBRIGHT	APT1608LVBC/D	DIODE; LED; BLUE WATER CLEAR; BLUE; SMT (0603); VF=2.65V; IF=0.002A
12	FAULT, LPBK	-	2	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER;
13	IOREF, VL_EXT	-	2	5000	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
14	JU1, JU14	-	2	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC
15	JU2-JU5, JU7, JU9, JU10, JU16, JU20	-	9	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC
16	JU6, JU15, JU_CANH, JU_CANL	-	4	PBC03SAAN	SULLINS	PBC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS; -65 DEGC TO +125 DEGC
17	JU8	-	1	TSW-113-07-T-T	SAMTEC	TSW-113-07-T-T	CONNECTOR; MALE; THROUGH HOLE; 0.025IN SQ POST HEADER; STRAIGHT; 39PINS ;
18	JU11, JU17	-	2	SSQ-108-24-G-S	SAMTEC	SSQ-108-24-G-S	CONNECTOR; FEMALE; THROUGH HOLE; .025INCH SQ POST SOCKET; STRAIGHT; 8PINS ;
19	JU12	-	1	TSW-104-07-L-S	SAMTEC	TSW-104-07-L-S	EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 4PINS
20	JU13	-	1	OSTTA024163	ON-SHORE TECHNOLOGY INC.	OSTTA024163	CONNECTOR; FEMALE; THROUGH HOLE; 5.08MM TERM BLOCK CONNECTOR; STRAIGHT; 2PINS; -30 DEGC TO +105 DEGC
21	JU18	-	1	SSQ-106-24-G-S	SAMTEC	SSQ-106-24-G-S	CONNECTOR; FEMALE; THROUGH HOLE; .025INCH SQ POST SOCKET; STRAIGHT; 6PINS ;
22	JU19	-	1	SSQ-110-24-G-S	SAMTEC	SSQ-110-24-G-S	CONNECTOR; FEMALE; THROUGH HOLE; .025INCH SQ POST SOCKET; STRAIGHT; 10PINS ;
23	R1-R3	-	3	CRCW0201300RFK	VISHAY DALE	300	RES; SMT (0201); 300; 1%; +/-100PPM/DEGC; 0.0500W
24	R4	-	1	CRCW040226K1FK	VISHAY DALE	26.1K	RES; SMT (0402); 26.1K; 1%; +/-100PPM/DEGC; 0.0630W
25	R5, R6	-	2	CRCW060360R4FK	VISHAY DALE	60.4	RES; SMT (0603); 60.4; 1%; +/-100PPM/DEGC; 0.1000W
26	R7	-	1	CRCW121060R4FKEAHP	VISHAY DRALORIC	60.4	RES; SMT (1210); 60.4; 1%; +/-100PPM/DEGC; 0.7500W
27	R8, R10, R12, R16	-	4	CRCW04021K80FK; RC0402FR-071K8L	VISHAY DALE;YAGEO PHICOMP	1.8K	RES; SMT (0402); 1.8K; 1%; +/-100PPM/DEGC; 0.0630W
28	R9, R11, R13, R14	-	4	CRCW04023K30FK	VISHAY DALE	3.3K	RES; SMT (0402); 3.3K; 1%; +/-100PPM/DEGC; 0.0630W
29	R17	-	1	CRCW0201100KFK	VISHAY DALE	100K	RES; SMT (0201); 100K; 1%; +/-100PPM/DEGC; 0.0500W
30	SU1-SU17, SU4_1	-	18	S1100-B;SX1100-B; STC02SYAN	KYCON;KYCON; SULLINS ELECTRONICS CORP.	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT;PHOSPHOR BRONZE CONTACT=GOLD PLATED
31	TP1, TP2, TP17, TP19	-	4	5011	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
32	U1	-	1	MAX33015EATB+	MAXIM	MAX33015EATB+	EVKIT PART - IC; TXRX; +5V; 5MBPS CAN TRANSCEIVER WITH +/-65V FAULT PROTECTION FAULT DETECTION AND REPORTING; +/-30V CMR AND +/-25KV ESD PROTECTION; PACKAGE OUTLINE DRAWING: 21- 0137; LAND PATTERN NUMBER: 90-0003; PACKAGE CODE: T1033+1C; TDFN10-EP
33	U2	-	1	MAX14131FAEE+	MAXIM	MAX14131FAEE+	IC; DISO; 3/1 CHANNEL; 1KV RMS DIGITAL ISOLATORS; QSOP16
34	VDD_EXT	-	1	5010	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
35	PCB	-	1	MAX33015ESHIELD	MAXIM	PCB	PCB;MAX33015ESHIELD
36	C7	DNP	0	C1005X7R1E473K050BC; GRM155R71E473K; GCM155R71E473KA55	TDK;MURATA;MURATA	0.047UF	CAP; SMT (0402); 0.047UF; 10%; 25V; X7R; CERAMIC
37	R15	DNP	0	N/A	N/A	OPEN	RESISTOR; 0402; OPEN; FORMFACTOR
<b>TOTAL</b>			<b>87</b>				

PRELIMINARY

MAX33015E Shield Schematic

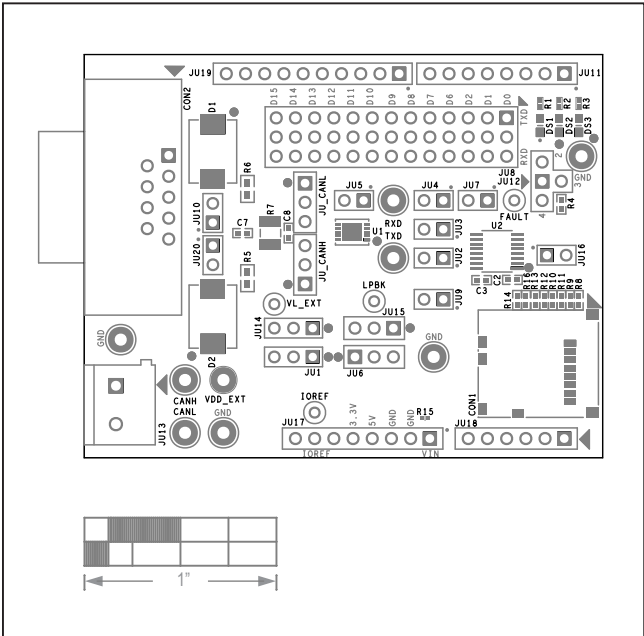


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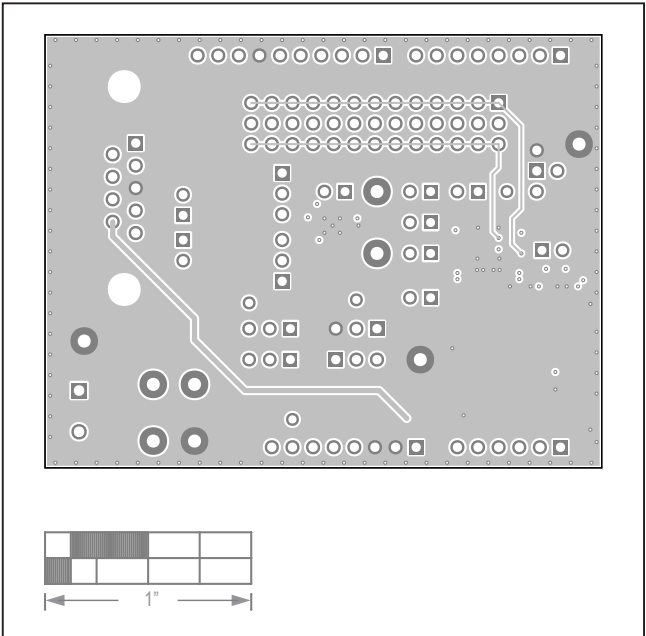
MAX33015E Shield

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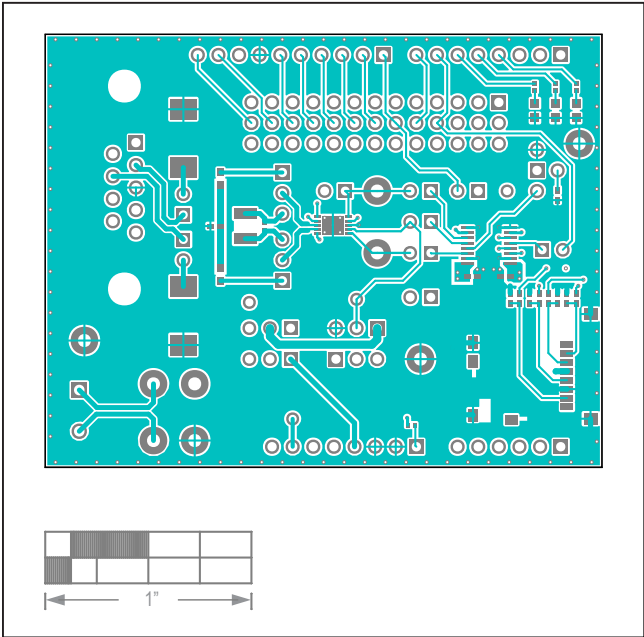
MAX33015E Shield PCB Layout



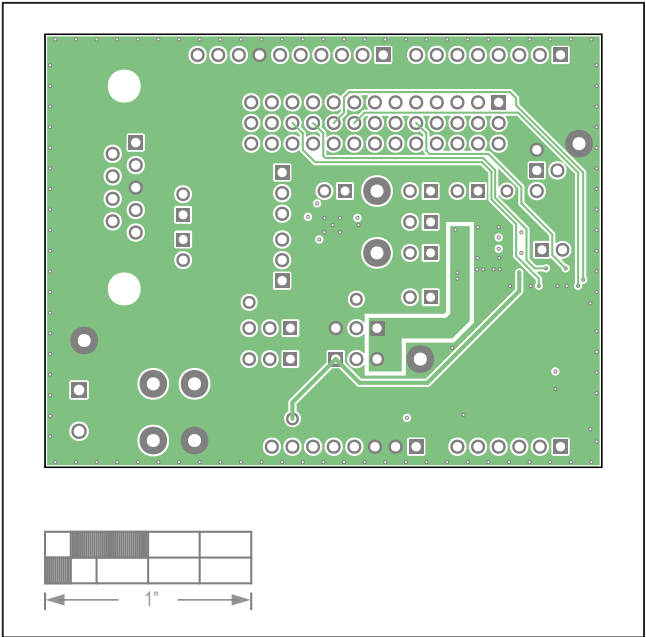
MAX33015E Shield—Top Silkscreen



MAX33015E Shield—Internal 2



MAX33015E Shield—Top



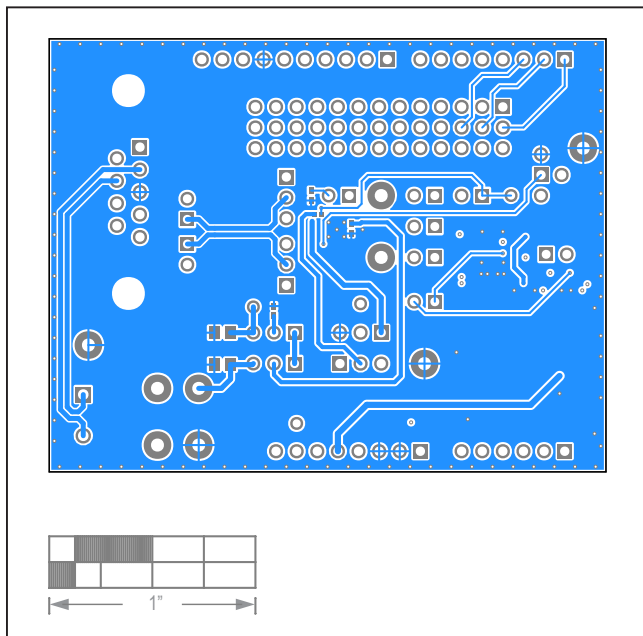
MAX33015E Shield—Internal 3

PRELIMINARY

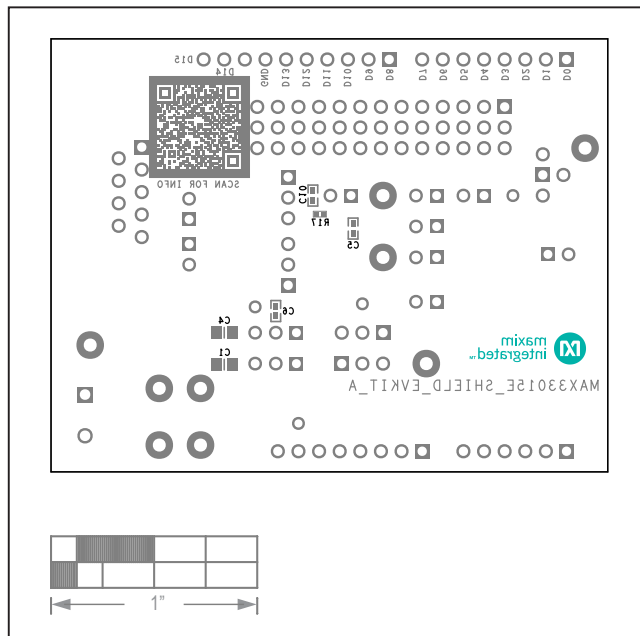
## MAX33015E Shield

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### MAX33015E Shield PCB Layout



MAX33015E Shield—Bottom



MAX33015E Shield—Bottom Silkscreen

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MAX33015E Shield

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MAX33015E

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/21	Initial release	—
1	4/21	Updated part number	1–9

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